

CLAIMS

We claim:

1        1. A semiconductor structure, comprising:  
2              a first substrate;  
3              a second substrate joined to the first substrate;  
4              a plurality of contacts between the first substrate and  
5              the second substrate; and  
6              a plurality of first solder bumps connected between the  
7              first substrate and the second substrate for aligning the  
            contacts.

1        2. The semiconductor structure according to claim 1,  
2        wherein the contacts have a different composition than the  
            first solder bumps.

1        3. The semiconductor structure according to claim 1,  
2        wherein at least one of the first substrate and the second  
            substrate is an integrated circuit chip.

1        4. The semiconductor structure according to claim 1,  
2        wherein the contacts comprise second solder bumps.

1           5. The semiconductor structure according to claim 4,  
2       wherein the second solder bumps have a smaller size than the  
first solder bumps.

1           6. The semiconductor structure according to claim 1,  
2       wherein the contacts have a smaller size than the first  
solder bumps.

1           7. The semiconductor structure according to claim 1,  
wherein the contacts comprise electrically conductive epoxy.

1           8. The semiconductor structure according to claim 1,  
wherein the contacts comprise a polymer-metal composite.

1           9. The semiconductor structure according to claim 1,  
2       wherein the contacts comprise at least one member selected  
3       from the group consisting of dendrites and self-interlocking  
micro connectors.

1           10. The semiconductor structure according to claim 1,  
2       wherein the contacts each have a diameter of less than about  
50  $\mu$ m.

1           11. The semiconductor structure according to claim 1,

wherein the contacts each have a diameter of about 10  $\mu\text{m}$ .

1           12. The semiconductor structure according to claim 1,  
2 wherein the contacts each have a diameter of less than about  
10  $\mu\text{m}$ .

1           13. The semiconductor structure according to claim 1,  
wherein the contacts have a pitch of less than about 100  $\mu\text{m}$ .

1           14. The semiconductor structure according to claim 1,  
wherein the contacts have a pitch of about 30  $\mu\text{m}$ .

1           15. The semiconductor structure according to claim 1,  
2 wherein the contacts have a diameter about 20% of the  
diameter of the first solder bumps.

1           16. The semiconductor structure according to claim 1,  
2 wherein the contacts comprise a material having a higher  
melting point than the first solder bumps.

1           17. The semiconductor structure according to claim 1,  
2 wherein an upper surface of the contacts and an upper  
surface of the first solder bumps are co-planar.

1           18. The semiconductor structure according to claim 1,  
2       further comprising:

3           a ledge on at least one of the first substrate and the  
4       second substrate, wherein the first solder bumps are  
5       arranged in contact with the ledge, such that an upper  
6       surface of the contacts and an upper surface of the first  
solder bumps are co-planar.

1           19. The semiconductor structure according to claim 1,  
wherein the contacts comprise a material other than solder.

1           20. The semiconductor structure according to claim 1,  
wherein the contacts comprise solder.

1           21. The semiconductor structure according to claim 1,  
wherein the contacts comprise PMC.

1           22. The semiconductor structure according to claim 1,  
2       wherein the contacts provide optical communication between  
the first substrate and the second substrate.

1           23. The semiconductor structure according to claim 1,  
wherein the contacts comprise a waveguide.

1           24. The semiconductor structure according to claim 1,  
2 wherein the contacts comprise an optical transmitter and an  
optical receiver.

1           25. The semiconductor structure according to claim 1,  
2 wherein at least one of the first substrate and the second  
3 substrate is an integrated circuit chip, and the contacts  
4 are sufficiently small to permit alignment of individual  
devices on the integrated circuit chips.

1           26. A method of fabricating a semiconductor structure,  
2 the method comprising:  
3           providing a first substrate and a second substrate;  
4           providing contacts on one of the first substrate and  
5 the second substrate;  
6           providing first solder bumps on one of the first  
7 substrate and the second substrate;  
8           mounting the first substrate on the second substrate;  
9           and  
10          reflowing the first solder bumps for surface tension  
aligning of the contacts.

1           27. The method according to claim 26, wherein the  
2 contacts have a different composition than the first solder

bumps.

1           28. The method according to claim 26, wherein at least  
2         one of the first substrate and the second substrate is an  
integrated circuit chip.

1           29. The method according to claim 26, wherein the  
contacts comprise second solder bumps.

1           30. The method according to claim 29, further  
2         comprising:

3           reflowing the second solder bumps, wherein the second  
4         solder bumps ball up to make contact between the first  
substrate and the second substrate.

1           31. The method according to claim 29, wherein the  
2         second solder bumps comprise a material having a higher  
3         melting point than the first solder bumps, and reflowing the  
4         second solder bumps requires heating the second solder bumps  
5         to a higher temperature than reflowing the first solder  
bumps.

1           32. The method according to claim 29, wherein the  
2         second solder bumps are provided with a smaller size than

the first solder bumps.

1           33. The method according to claim 26, wherein the  
contacts comprise electrically conductive epoxy.

1           34. The method according to claim 26, wherein the  
contacts comprise a polymer-metal composite.

1           35. The method according to claim 26, wherein  
2           reflowing the first solder bumps draws the first substrate  
3           toward the second substrate to cause the contacts to make  
contact with the first substrate and the second substrate.

1           36. The method according to claim 26, wherein the  
2           first solder bumps contact the first substrate and the  
3           second substrate prior to the contacts making contact  
between the first substrate and the second substrate.

1           37. The method according to claim 26, wherein the  
contacts are provided by thin film processing.

1           38. The method according to claim 37, wherein the thin  
2           film processing comprises lift off stencil or subtractive  
etch.

DATE 02/22/2003

1           39. The method according to claim 26, wherein the  
2 contacts each are provided with a diameter of less than  
about 50  $\mu\text{m}$ .

1           40. The method according to claim 26, wherein the  
contacts each are provided with a diameter of about 10  $\mu\text{m}$ .

1           41. The method according to claim 26, wherein the  
2 contacts each are provided with a diameter of less than  
about 10  $\mu\text{m}$ .

1           42. The method according to claim 26, wherein the  
2 contacts are provided with a pitch of less than about 100  
 $\mu\text{m}$ .

1           43. The method according to claim 26, wherein the  
contacts are provided with a pitch of about 30  $\mu\text{m}$ .

1           44. The method according to claim 26, wherein the  
2 contacts are provided with a diameter about 20 % of the  
diameter of the first solder bumps.

1           45. The method according to claim 26, wherein the  
2 contacts are provided with a smaller size than the first

solder bumps.

1           46. The method according to claim 26, wherein the  
2 contacts provide optical communication between the first  
substrate and the second substrate.

1           47. The method according to claim 26, wherein the  
contacts comprise a waveguide.

1           48. The method according to claim 26, wherein the  
2 contacts comprise an optical transmitter and an optical  
receiver.

1           49. The method according to claim 26, wherein the  
2 contacts comprise at least one member selected from the  
3 group consisting of dendrites and self-interlocking micro  
connectors.

1           50. The method according to claim 26, wherein the  
2 contacts and the first solder bumps are provided such that  
3 an upper surface of the contacts and an upper surface of the  
first solder bumps are co-planar.

1           51. The method according to claim 26, wherein the

2 contacts comprise at least one member selected from the  
3 group consisting of solder, a material other than solder,  
and PMC.

1 52. The method according to claim 26, further  
2 comprising:

3 providing a ledge on at least one of the first  
4 substrate and the second substrate, wherein the first solder  
5 bumps are arranged in contact with the ledge, such that an  
6 upper surface of the contacts and an upper surface of the  
first solder bumps are co-planar.

1 53. The method according to claim 26, wherein the  
2 contacts are compressed as the first solder bumps are  
reflowed.